LETTERS

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A POSSIBLE CASE OF DOUBLE BROODING OF EAGLE-OWLS (*BUBO BUBO*) IN SPAIN

Multiple breeding in the same reproductive season is a common life-history tactic by which individuals can increase their genetic representation in future generations (Roff 2002, Life history evolution. Sinauer, Sunderland, U.K.) However, this strategy implies costs in terms of survival, future fledgling production, or both, although such costs of reproduction depend closely on environmental conditions (Verhulst 1998, *Funct. Ecol.* 12:132–140). Perrins (1970, *Ibis* 112:242–255) hypothesized that females should start laying as soon as they are physiologically capable, and that interindividual differences in the timing of breeding could be caused by differential acquisition of food (food supply hypothesis). Early laying pairs are expected to be more able to carry out second clutches than pairs that lay later, because females are in a better physiological condition and they have time enough for additional breeding attempts in the same reproductive season (e.g., Morrison 1998, *Auk* 115:979–987; Marks and Perkins 1999, *Wilson Bull.* 11. 273–276). Laying second and even third clutches has been reported as usual in a wide variety of bird species, mainly passerines (e.g., Friesen et al. 2000, *Wilson Bull.* 112:505–509; Mahony et al. 2001, *Wilson Bull.* 113:441–444), while it is considered as exceptional in others (e.g., Miller 2003, *Wilson Bull.* 115:94–95). In raptors, there are reports of double clutches (Newton 1979, Population ecology of raptors. T. & A.D. Poyser, London, U.K.), although most of them correspond to small-sized species with short reproductive periods and in favorable areas or years of high food availability (e.g., Korpimäki 1988a, *J. Anim. Ecol.* 57:1027–1039; Marks and Perkins 1999). For large species with long reproductive periods, even replacement clutches are rarely reported (Newton 1979, Bull and Henjum 1990, Ecology of the Great Gray Owl. USDA For. Serv. Gen. Tech. Rept. PNW-GTR-265, Portland, OR U.S.A.; Cabeza and de la Cruz 2001, *Ardeola* 48:233–236; Margalida and Bertran 2002, *J. Raptor Res.* 36:154–155; Martínez and Blanco 2002, *Ardeola* 49 297–299). Owls of the family Strigidae typically raise no more than one brood per year, but some records of double brooding have been reported (Kellomaki et al. 1977, *Ornis Fenn.* 54:124–135; Millsap and Bera 1990, *Wilson Bull.* 102. 313–317; Forsman et al. 1997, *Condor* 97:1078–1080; Marks and Perkins 1999). Replacement clutches are known for Eurasian Eagle-Owls (*Bubo bubo*) (e.g., Blondel and Badan 1976, *Nos Oiseaux* 33:189–219), but only one possible double clutch has been reported in southeastern Spain (Martínez et al. 2003, *Ardeola* 50:77–79).

Collaborators and I have monitored a Eurasian Eagle-Owl population since 1999 in the province of Toledo, central Spain (39°47′N, 4°04′W). The study area extends over 2400 km^2 with meso-mediterranean climate, with mean temperatures of 26°C and 5°C in July and January, respectively, and 300–400 mm of rainfall concentrated in spring and autumn. To date, we have located 100 pairs of eagle-owls, but we estimated that at least twice this number could be breeding in the study area. Mean nearest neighbor distance (hereafter NND; $\bar{x}$ = 1.4, SD = 1.7 km, N = 100) is the lowest, whereas clutch size ($\bar{x}$ = 3.67, SD = 0.53, N = 36) and mean number of fledglings per successful pair ($\bar{x}$ = 2 72, SD = 0.78, N = 50; J. Ortego unpubl. data) is the highest reported to date (Marchesi et al. 2002, *Ibis* 144:164–177). These population traits are likely related to the fact that rabbit (*Oryctolagus cuniculus*) density in the study area is one of the largest reported for the Iberian Peninsula (Blanco 1998, Mamíferos de España. Geoplaneta, Barcelona, Spain).

On 13 April 2002, I found three fledged chicks, which flew away when we approached them, around the nest of an eagle-owl pair. Approximately 50 m away from this nest, and in the same cliff, I found an adult bird incubating two eggs. In spite of the high density of eagle-owls in the study area, it seems unlikely that the second clutch belonged to a different pair. Eagle-owls are closely linked to ravines in the study area, which provide both nest sites with low human disturbance and high rabbit availability (Ortego and Díaz in press, Selección del hábitat de nidificación del búho real [*Bubo bubo hispanus*] en la provincia de Toledo. *In* Actas de las XVI jornadas ornitológicas españolas. Sociedad Española de Ornitología, Madrid, Spain). The minimum NND recorded in the study area was 150 m, and the minimum mean for pairs living in the same ravine was 389 m (N = 14 pairs). The NND for the pairs settled in the ravine where the reported nest was located was 895 m (N = 11). This relatively low density makes the settlement of two pairs in the same cliff unlikely.

According to chick development, I estimated the laying date for the three fledglings around 5 January. Laying date of this pair in the following breeding season was estimated around 19 December, the earliest for a sample of 31 pairs ($\bar{x}$ = 28 January, SD = 17.5). The early laying date of this pair could have facilitated a second clutch (Morrison 1998; Marks and Perkins 1999; however, see Martínez et al. 2003). In addition, in the previous breeding season I found 17 young rabbits in this nest when the last egg was still hatching. Storage of rabbits in the nest before hatching is common in our study area (J. Ortego unpubl. data), and I have never noticed such a large number of rabbits in a sample of 36 nests. These data suggest that the pair involved could be living in a high quality territory that yields relatively large numbers of available prey of high-energetic value, consequently minimizing the costs of a multiple brooding (Verhulst 1998, *Funct. Ecol.* 12:132–140).

Martínez et al. (2003) offered two alternative explanations that could explain the apparent double-brooding observations in southwestern Spain. Death of the female could have allowed the male to pair with another female physiologically ready to start the reproduction, or the male could have been polygynous (Bull and Henjum 1990), as has been observed in other raptors responding to a superabundant food supply (Korpimäki 1988b, *Oecologia* 77. 278–285; Marti 1992, *Condor* 92:261–263). The latter explanation, polygyny, would be an usual breeding behavior in the eagle-owl (Dalbeck et al. 1998, *Vögelwelt* 119:331–344). Neither the pair reported by Martínez et al. (2003), nor the pair reported here were marked, so it was not possible to conclude if a lone pair was involved, or if a replacement, or if two females were involved in these cases of double-brooding. Nevertheless, all proposed explanations are likely related to the effects of high prey availability on the reproductive behavior of eagle-owls, which can reduce reproductive costs and lead to multiple breeding attempts. Such conditions in Spain seem to be infrequent, especially after the recent population crash of rabbits (Villafuerte et al. 1995, *Mammalia* 59:651–659; Martínez and Calvo 2001, *J Raptor Res.* 35:259–262; Martínez and Zuberogoitia 2001, *J. Ornithol.* 142:204–211). However, intensive research in high-prey situations, such as reported here may provide further examples of double brooding that could be more common than previously thought (Marks and Perkins 1999; Mahony et al. 2001).

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Insect Hawking Observed in the Long-eared Owl (*Asio otus*)

The Long-eared Owl (*Asio otus*) has been described as a specialist on a relatively narrow range of species of small mammals (Errington 1932, *Condor* 34:176–186; Craighead and Craighead 1979, Hawks, owls, and wildlife. Stackpole Co., Harrisburg, PA U.S.A; Marks and Marks 1981, *Murrelet* 62:80–82), and highly dependent on *Microtus* spp in many parts of North America and Europe (Marks 1984, *Can. J. Zool.* 62:1528–1533; Marks and Marti 1984, *Ornis Scand.* 15:135–143). *Asio otus* has also been found to shift dietary preference seasonally among different *Microtus* spp. in southern Sweden and among other small mammals in central Slovenia (Nilsson 1981, *Ornis Scand.* 12:216–223, Tome 2003, *Ornis Fenn.* 80:63–70).

Invertebrates are a minor component of this species' diet (0.5–0.2% by number, <0.1% by mass; Marti 1974, *Condor* 76:45–61; Marti 1976, *Condor* 78:331–336; Tome 1994, *J. Raptor Res.* 28:253–258; Alivizatos and Goutner 1999, *J. Raptor Res.* 33:160–163) as are larger prey, such as juvenile (100–150 g) lagomorphs (0.75% by number, 2.5% by biomass, Marks 1984).

Foraging behavior among Long-eared Owls is less understood than diet. The long-pointed wings and relatively low-wing loading of Long-eared Owls suggests the ability to hunt aerially, which has been observed in the form of quartering the ground for prey. Such adaptations are similar to Caprimulgids such as the Common Nighthawk (*Chordeiles minor*) which "hawk" prey aerially (catching prey on the wing; Poulin et al. 1996, Common Nighthawk (*Chordeiles minor*), *In* A. Poole and F. Gill [Eds.], The birds of North America, No. 213. The Birds of North America, Inc., Philadelphia, PA U.S.A.). In the Long-eared Owl, hawking behavior has never been documented (Marks et al 1994, Long-eared Owl (*Asio otus*), *In* A. Poole and F. Gill [Eds.], The birds of North America, No. 133. The Birds of North America, Inc., Philadelphia, PA U.S.A.). There are very few published observations of Long-eared Owl foraging